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ABSTRACT

This learner manual for rescuers covers the current techniques or practices required in the rescue service. The seventh of 10 modules contains information on extrication from vehicles. Key points, an introduction, and conclusion accompany substantive material in this module. In addition, suggested tools and equipment for extrication procedures are listed. (NLA)

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RESCUE MANUAL

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MODULE 7

Extrication From Vehicles

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CE 057 714

INSTRUCTIONAL MATERIALS LABORATORY
THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO 43210

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Rescue operations may subject both rescuer and victim to the possibility of injury or death. Rescuers must understand the nature and effect of each rescue technique, and practice techniques regularly, using this text to enhance their learning. The materials and information presented here are intended only as a learning aid, and are no substitute for training. Expert opinions, recommendations, and guidelines change as research and experience refine procedures. This text includes the most up-to-date information from rescuers working in the field. When applicable, the standards of the National Fire Protection Association (NFPA) and Occupational Safety and Health Administration (OSHA) have been followed for this text.

Specialized procedures require demonstration and training by subject-matter experts. It is not likely that a rescuer will become proficient in all rescue operations. Most rescuers develop proficiency in only a few areas but may be familiar with several others.

This text suggests procedures and explains how to do them. The techniques given are guidelines only. Each department should incorporate its own procedures and address local needs.

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RESCUE MANUAL

INSTRUCTIONAL MATERIALS LABORATORY
THE OHIO STATE UNIVERSITY
COLUMBUS, OHIO 43210

EXTRICATION FROM VEHICLES

Acknowledgment is extended to the following persons for their willingness to share their knowledge and expertise and for authoring information presented in this module:

Lee Curry, Columbus Division of Fire, Columbus, Ohio

Greg Lash, Columbus Division of Fire, Columbus, Ohio

John Mason, Technical Consultant, Medina, Ohio

Daryle Oakes, Technical Consultant, Columbus, Ohio

FOREWORD

The intent of this manual for rescuers is to provide the latest instructional content and serve as an up-to-date, comprehensive source of information covering the current techniques or practices required in the rescue service. To help in this endeavor, an instructor's manual has been developed to be used in conjunction with this learner's manual. The manual has been produced in a series of modules to facilitate future revisions more rapidly and cost effectively.

The instructor's manual follows the key points identified in the text. Chapters have been included in the text which exceed those printed in any other resource. These include managing and operating the emergency vehicle, rope rescue techniques, industrial rescue, farm accident rescue, and various water emergency procedures, among others.

That the rescue profession is a dangerous and challenging career is a recognized fact. It is our hope that this text will help the rescuer meet the challenges of the rescue service in a safe and professional manner.

Tom Hindes
Director
Instructional Materials Laboratory
College of Education
The Ohio State University

PREFACE

The Ohio State University Instructional Materials Laboratory has played a major role in the training of public safety personnel through the development of text materials for many years. Due to the advances in the rescue techniques, it became apparent that the existing text was obsolete. Upon the advice of many knowlegeable people in the rescue service, the Instructional Materials Laboratory initiated the development of a new text that would be easily updated, and address the needs of the rescuer. To this end, an editorial review board representing a broad spectrum of individuals in the various phases of the rescue profession was convened to determine what topics this text should address. The culmination of this effort is the Rescue Manual. It is hoped that this text will be useful to not only the new rescuer but will serve as a reference source for the experienced rescuer.

Joyce Leimbach
Curriculum Consultant
College of Education
The Ohio State University

Ronald Slane
Technical Consultant
College of Education
The Ohio State University

MODULE 7

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EXTRICATION FROM VEHICLES

INTRODUCTION

Extrication of victims from vehicle accidents is the type of rescue work most frequently performed today. The basic skills and techniques used to extricate victims from wrecked vehicles should be acquired by all rescue personnel. These skills are used not only in extrication from vehicles, but also in situations involving equipment used in industrial and farm operations. Rescue personnel must be proficient in the use of all types of tools and equipment utilized for rescue operations, know when to use specific tools, and know the limitations of individual tools. Rescuers must know extrication procedures and be proficient with extrication techniques and the application of extrication tools during mock situations.

It is impossible to address every situation that may cause a person to become trapped in a vehicle; however, common practices will be addressed in this text. Common sense, imagination, and a working knowledge of rescue procedures and equipment are the rescuer's most important assets. It is important to not be afraid to try something different; action often leads to a solution. Rescue procedures require improvisation and innovative measures. In most cases, whatever is done to the vehicle will in some way affect the trapped victim; thus vehicle extrication must be thought of as a patient-care procedure.

Vehicle extrication can be divided into the following stages:

1. Size-up of scene and situation
2. Stabilization of the scene and vehicle
3. Gaining access to the trapped victim
4. Disentanglement of the victim
5. Removal of the victim

SIZE-UP OF SCENE AND SITUATION

The initial responsibility of rescue personnel, specifically the incident commander, is to sizeup the overall rescue scene. Hazards such as downed electrical lines, spilled fuels, or unsafe roadway areas should be identified immediately upon arrival at the scene. Fire protection personnel should be called to stand by with charged lines or appropriate fire-extinguishing agents for any accident involving a victim. If the accident occurs at night, the scene must be illuminated and marked with appropriate flares. If fuel or chemical spills are involved, rescue personnel must follow NFPA guidelines, and the fuel or chemical must be contained.

The incident commander should evaluate where and how the victims are trapped to determine what techniques will be used to execute the rescue. Once these determinations have been made, the rescue procedures should be explained to all rescue personnel so they can operate efficiently as a team.

The incident commander should continually monitor the procedures being implemented to ensure the safety and well-being of the victims and rescue personnel. As the rescue progresses the incident commander must make necessary adjustments in procedures in the event that the original plan or the equipment does not work.

STABILIZATION OF THE SCENE AND VEHICLE

After the scene has been sizedup and the hazards have been identified, the rescuers must proceed to make a stable and safe working environment. Potential fire is a major concern; in vehicle accidents all elements are present to support combustion.

The first thing that should be done is to eliminate the electrical current throughout the vehicle. This can be done in two steps. Turn the vehicle's ignition to the off position and then disconnect the battery cables; always disconnect the grounding cable first. When disconnecting battery cables, be aware of combustible gas coming from the battery. A spark near this gas may cause an explosion and fire. Once the electrical system has been disabled, any fuel or chemical spillage should be identified and controlled using appropriate fire-fighting agents.

Another concern at an accident scene is the involvement of high-voltage electrical lines. If a downed electrical line is in contact with a vehicle, the line should *not* be moved or manipulated by rescue personnel unless the situation is life-threatening or the power company is unable to respond to the scene. The scene should be cleared of bystanders until the power company handles the downed wires. No wire should be considered dead until the electric company personnel declare it so.

If the rescuers must deal with downed wires, only equipment approved for handling electrical equipment, such as lineperson's gloves, clamp sticks, and/or telescoping hot sticks (see Figure 1) should be used.

When working at a highway incident, moving traffic must be controlled to make the scene safe for rescuers. (See the chapter on vehicle management and operations.) Once the scene has been made safe, the involved vehicle must be stabilized to assure the safety of the victims and the rescue personnel.

Stabilizing the Vehicle

The incident commander should determine whether the vehicle is in a stable position. Even when sitting on its wheels, *the vehicle can be unstable* and can contribute to further injury of a trapped victim. The vehicle is considered stable when it can no longer rock or bounce, and is in a solidly secured position. Equipment used for stabilization of the vehicle may include, but is not limited to, wood cribbing, step blocks, come-alongs, cables, ropes, hydraulic jacks or rams, and winches.

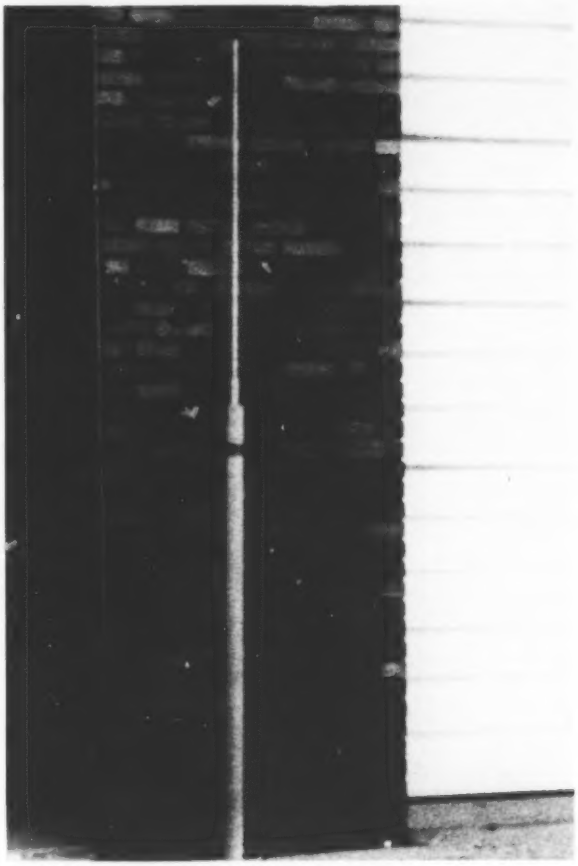

Figure 1. Telescoping Hot Stick

All vehicles must, at the very least, have their suspensions immobilized to prevent rocking during extrication. Movement of the vehicle may cause further injury to the victim. Suspension immobilization can be achieved by implementing the following procedure:

First, place four step blocks (see Figures 2-A and 2-B) under the vehicle until they are touching the frame. If step blocks are not available, a box crib can be built using wood supports such as lengths of 4″ × 4″ and/or 2″ × 4″ (see Figure 3). The blocks or cribs should be placed immediately in front of the rear wheels and immediately in back of the front wheels. Next, the air should be released from the tires so the vehicle is positioned on the blocks (see Figure 4).

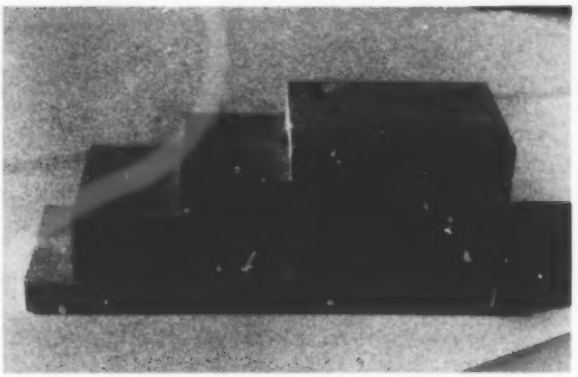

Figure 2-A. Step Blocks

Figure 2-B. Positioning Step Blocks

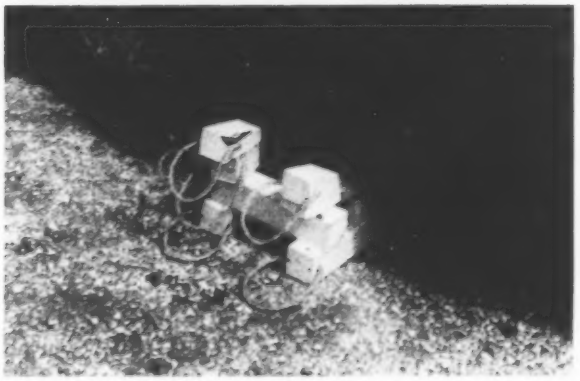

Figure 3. Box Cribbing Supplies

Stabilizing the Overturned Vehicle

When a vehicle is found lying on its side or top, or partially hanging over an embankment, it must be stabilized before rescuers can enter to remove the trapped victim. A variety of tools and improvisations can be used, but the rescuer must use common sense and not take any unnecessary risks.

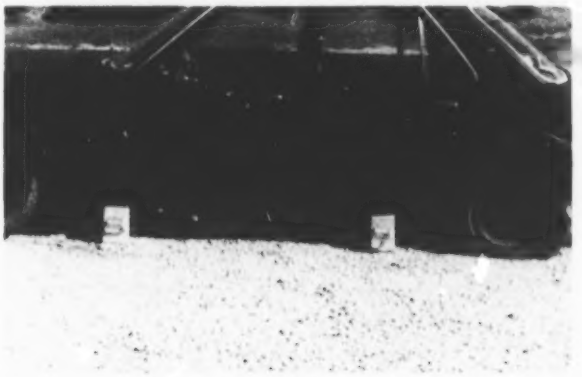

Figure 4. Tire Air Released for Vehicle Stabilization

Cribbing made from wood supports such as 4" x 4"'s and/or 2" x 4"'s cut into 16" or 18" lengths can be used to stabilize vehicles. Along with the pieces of cribbing it is necessary to have 4" x 4" wedges and some pieces of plywood approximately 2' square x 3/4" thick to use as solid bases for the box cribs when unstable ground conditions are encountered (see Figure 5). It is also advisable to have additional 4" x 4" cribbing in 36" to 60" lengths in the event a broad-base support is needed. Cribbing is normally arranged in box cribs, making sure the weight is distributed evenly around the box.

A tool useful for stabilization is the heavy-duty come-along, capable of pulling at least two tons. A set of puller chains (see Figure 6) can be used to secure the come-along to a stationary object and to the vehicle to be stabilized.

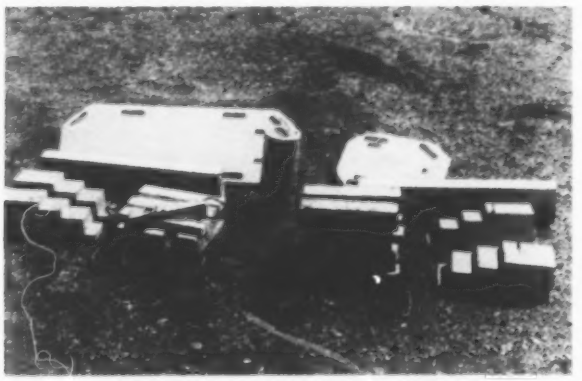

Figure 5. Wedges and Plywood Used for Stabilizing a Vehicle

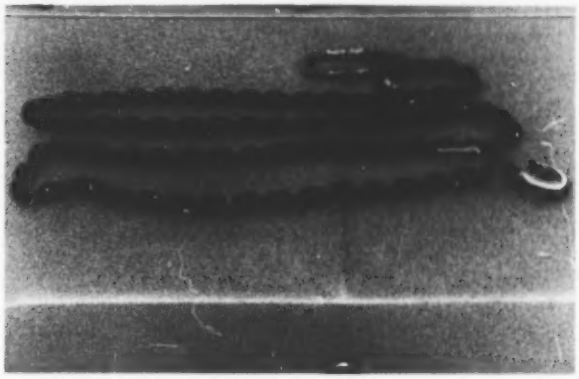

Figure 6. Puller Chain

The come-along can be put into service quickly as long as a large stationary object such as a tree, concrete pillar, or heavy vehicle is available to be used as an anchor. Secure the come-along to the stationary object with the cable extended to the vehicle to be stabilized and attached with a chain. Next, operate the come-along until the cable is tightened and the vehicle is stable. Remember that when using this method the vehicle must be secured from opposite directions in order for it to be totally stabilized. Vehicle winches may also be used in the same manner as a come-along, as long as the vehicle to be stabilized is secured from opposite directions.

The mechanically-powered hydraulic ram can be used in a manner similar to the come-along (see Figure 7). Attach the grab hooks to the ends of the rams with chains attached both to the anchor and the vehicle. Next, extend the ram completely with the chains attached to the grab hooks. Then, retract the ram until the chains are tight and the vehicle is solid. Approximately 8,000 pounds of pulling force is available when using the ram.

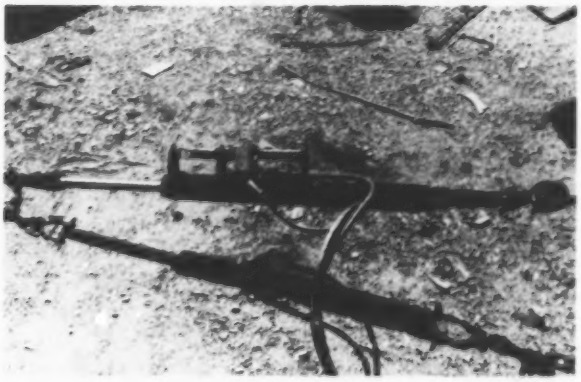

Figure 7. Hydraulic Ram Used for Stabilization (Pulling)

The hydraulic ram can also be used in a pushing manner to stabilize a vehicle (see Figure 8). To do this, place the ram at an angle of about 45 degrees between the ground and the vehicle, and extend it until the vehicle is tightly secured. It is recommended that a piece of cribbing be placed under the base of the ram to increase the surface area that the ram has to push against. It may also be necessary to dig out the ground at the base of the ram so the ram will be pushing at a more direct angle.

Figure 8. Hydraulic Ram Used for Stabilization (Pushing)

The ram may be needed to perform another function during the rescue. Therefore, it should be used in stabilization only when necessary, since once the hydraulic ram is committed, it must stay in place. Manual and/or air-powered hydraulic jacks or rams

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may also be used to achieve stabilization in the same way as mechanical devices.

While air bags should be used primarily as lifting devices, they can also be used for stabilization (see Figure 9). Place the air bags next to or under a vehicle, and inflate them until the vehicle is stable. Air bags should never be used alone; wood cribbing must also be used to create a more solid, stable condition. Air bags used alone will allow some rocking or bouncing of the vehicle when the trapped victim or the rescuers move. This can cause air bags to slide out of place. Air bags also tend to slide when they come in contact with oil, gasoline, or antifreeze.

Figure 9. Air Bags Used for Stabilization

Stabilizing a Vehicle Resting on Its Roof

When a vehicle rolls onto its roof it will land in one of two positions. It may be held up by its roof support pillars, or the support pillars may collapse, allowing the vehicle to rest on the hood or trunk lid.

If the rolled vehicle is being supported by the roof-support pillars, additional support is needed to prevent the collapse of these pillars. Place wood supports made from 4" x 4" cribbing under the hood and trunk lid in a box-crib configuration to sustain the weight of the vehicle. If additional rescue procedures are required the vehicle will need to be supported so it will not collapse and injure the rescuers or complicate the situation.

Any of these tools or procedures can be used alone or together to secure a vehicle in order to protect the victim from further injury and prevent harm to the rescuer. Remember, the involved vehicle must be solidly secured and hazards must be eliminated to execute a successful rescue operation.

DEALING WITH THE VICTIM

Gaining Access to a Trapped Victim

Gaining access to a trapped victim is the third step in extrication from a vehicle. Rescuers need to reach the victim and start patient-care procedures such as airway management and bleeding control. Gaining access may require an operation as simple as opening a door or removing a window, or one as complex as removing the roof. Once access is gained, it is imperative that someone start patient care for the trapped victim before further rescue procedures are executed.

Some hand tools that may be useful in gaining access to the trapped victim include the spring-loaded center punch, a screwdriver, a hammer, a slim jim, and a pry bar.

When all the vehicle doors are locked and the windows are closed, it may be necessary to break the rear or side window farthest from the victim to gain access. This can be achieved by striking the window with some type of sharp object such as a spring-loaded center punch (see Figures 10-A and 10-B), the edge of a flat screwdriver, a pickaxe, or the pointed end of a Halligan tool. The windows at the rear and sides of a vehicle are made of a very strong tempered glass that shatters when stressed in the wrong way. Striking the corner of the window with a pointed object will probably be the most effective way to shatter the glass.

A vehicle's rear window provides a larger access opening and is usually farthest from the victim; thus, glass is less likely to fall on the victim. After breaking

Figure 10-A. A Spring-Loaded Center Punch

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Figure 10-B. Window Broken by Spring-Loaded Punch

out the window, lay a salvage cover over the broken glass to prevent injury to the rescuer and victim. Do not use a blanket for this procedure; glass can penetrate a blanket.

In some situations it may not be possible to break the glass due to the position of the victim, so a door must be opened to gain access. It may be necessary to use prying tools to open an unlocked vehicle door if the sheet metal is jammed together. Pry bars can open a jammed door more successfully if the door handle is held open while the door is pried. Often, even when a door is severely damaged, the latching mechanism still functions, if not by the outside handle, then by the inside handle. The major force securing the door (the latch and pin mechanism) is removed by holding the door latch open, and in most cases the rescuer can pry the door open with relative ease.

Preparing the Victim for Disentanglement

Before disentanglement procedures are implemented, the victim must be prepared both physically and psychologically. Physically the victim's cervical spine must be immobilized and the airway maintained to prevent further complications as a result of the extrication operation (see the chapter on patient care and handling for details). An aluminized blanket or salvage cover must be used to protect the victim from flying debris, glass, and/or spilled fluids that may come from the vehicle.

Mentally the victim should be made aware of the time that it may take to be removed and should be prepared for all of the activity and noise. This is accomplished by constantly explaining the procedures and the noises, thus reassuring the victim throughout the entire operation. One rescuer should establish a rapport with the victim and stay with the victim throughout the extrication operation.

Disentangling the Trapped Victim

When disentangling a victim, the primary concern is to remove the vehicle from around the victim to prevent any further injury to the victim and provide for safe removal. While performing disentanglement the rescue team must listen to the rescuer who is closest to the victim and is monitoring the effects of the rescue procedures on the victim. Always keep in mind the basic rule that for every action that takes place, an equal or opposite reaction occurs. That reaction could possibly cause further injury or harm the victim.

Communication among the rescuers is essential to successful disentanglement. The rescuer in charge must make sure all personnel at the scene know the extrication procedures and any changes in the initial extrication plan. As long as the victim's airway, bleeding, and circulation are maintained, disentanglement can be executed in a methodical manner; speed is usually not the most important factor.

FORCIBLE ENTRY PROCEDURES

The following procedures explain suggested methods of gaining access to the interior of an accident vehicle. It may be necessary to improvise other methods.

Door Opening and Removal

Usually, the first measures taken at the scene of a vehicle accident will be the opening or removal of the vehicle's doors. It cannot be over-emphasized **that all of the doors should always be checked to be sure one is not locked before using forcible entry procedures.** If the doors are locked, access can often be gained quickly with the use of a slim jim. Insert the slim jim between the door skin and the inner door panel to trip the locking mechanism, thus allowing the door to be opened (see Figures 11-A and 11-B).

As stated previously, the major mechanism holding a door closed is the latch-and-pin apparatus (see Figure 12). Since 1968 this has been a requirement

Figure 11-A. A Slim Jim

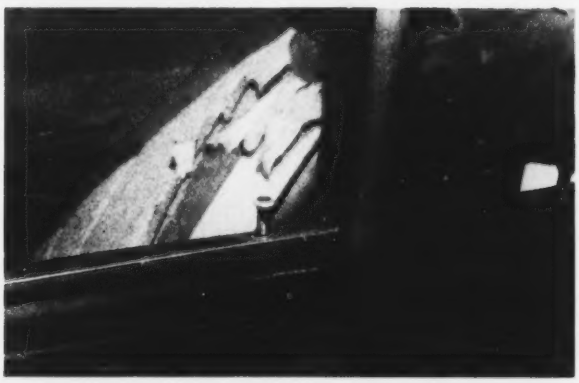

Figure 11-B. Door Unlocked by Slim Jim

Figure 12. Door Pin Mechanism

on all vehicles to prevent doors from flying open during a crash. Because of this latch-and-pin apparatus, it is important to have one rescuer hold the release handle open when using any type of tool to pry the door open. It may be necessary to expose the locking mechanism inside the door by cutting a hole in the door skin. This can be accomplished by using a can-opener type tool or an air chisel to cut the metal (see Figures 13-A and 13-B). To cut open a door, simple hand tools or a manually-operated hydraulic spreader and wedging tools are often sufficient. In extreme situations more sophisticated machinery or air-driven tools must be employed.

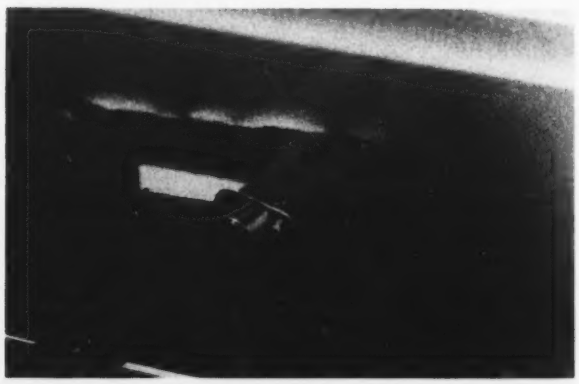

Figure 13-A. Cutting With Can-Opener Type Tool

Figure 13-B. Exposed Door Lock

It is very easy to use hand tools such as the pry bar, Halligan tool, hux bar, or porta-power to open doors. Simply hold the handle open, insert the tool in the seam of the door, and pry the door.

Sometimes a manually-operated hydraulic tool such as the spreader-wedge combination can be used to force a door open. The process is started by making an opening in the door seam that is large enough (approximately one inch) to allow insertion of the larger tools (see Figure 14). This can be achieved by inserting the paddle edge of a Halligan tool, pry bar, or other tool into the seam and twisting with

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Figure 14. Opening Made in a Door Seam

an upward and downward motion until the seam opens. Sometimes, due to the seam's tightness, the paddle has to be tapped into place.

The seam can be opened further with the wedge tool to allow room for the spreader tool. Continue to work the two tools above and below the latching mechanism to pry the door open. It is a good idea to have someone put pressure against the door during the prying procedure to prevent it from flying open when it lets go. For the most effective job, the wedge and spreader must always be used together (see Figure 15).

Figure 15. Wedge and Spreader Used Together

Once a vehicle door has been opened, it is sometimes necessary to remove the door completely to access the victim. When doors are bolted to the frame, remove the bolts. A regular socket and ratchet or wrench can be used, but faster results will be achieved with an air ratchet (see Figure 16).

When doors are welded to the frame it may be necessary to use the come-along and chain method

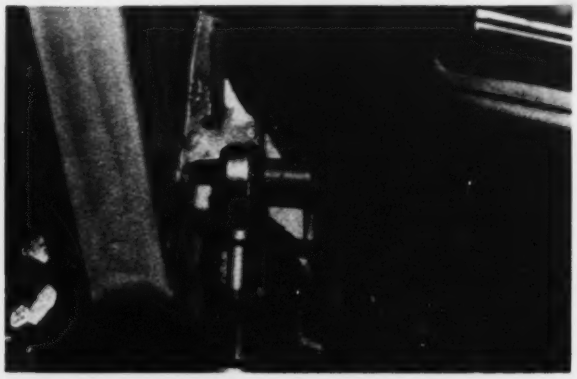

Figure 16. Air Ratchet Used to Remove Bolts

for pulling the door out of the way. Secure a chain to the frame, and bring it up over the front fender. Attach the come-along to this anchor chain near the body of the vehicle. It may be necessary to hold the chain in place by driving a pickaxe into the fender (see Figures 17-A and 17-B). Next, extend the cable

Figure 17-A. Anchor Chain in Place

Figure 17-B. Pickaxe and Come-Along in Place

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to the door and attach it to a chain secured to the outer edge of the door. Finally, tighten the cable and then pull the door back to the fender so it is out of the way (see Figures 18-A and 18-B).

It is sometimes necessary to use a mechanically or air-powered spreader tool to provide more force in opening the doors. However, even though these tools have the power to rip the latching mechanism apart, using them may take more time. This is why the rescuer should always try to unlatch the mechanism while using any tool.

Spreader Tools

The following text explains suggested approaches to using mechanical or air-powered spreaders for opening and removing doors.

Forcing a Door From the Handle Side. If a door's edge is not sprung outward by the impact it may not be possible to insert the tips of the mechanical or air-powered spreader into the gap between the door and the pillar. If this is the case, a small starting hole or gap must be created with a paddle-type pry bar.

Figure 18-A. Come-Along and Chain Attached to Vehicle Door

Figure 18-B. Door Pulled Toward Front Fender

The spreader can then be opened about one inch and inserted over the lip created by the paddle tool. Next, grasp the lip firmly, using the spreader like a large pair of pliers. Push the spreader to the side to bend the lip back, thus widening the gap enough to insert the tip of the spreader (see Figure 19).

Figure 19. Widening a Door Seam With the Hydraulic Spreader

Another technique that can be used to make a gap in the door is to position the hydraulic spreader so that it will open vertically near the lock (see Figure 20). Rest one spreader tip on the door and the other tip on the underside of the roof frame. Spread the arms so that the upper door frame is forced upward and the body of the vehicle pushed

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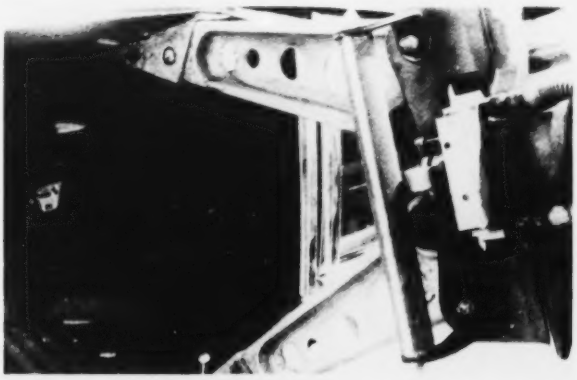

Figure 20. Hydraulic Spreader Positioned Vertically Over a Door Lock

downward. This operation will cause the gap between the door's edge and the pillar to widen so that the spreader tips can be inserted near the lock.

A major problem with this technique is that the door may be forced inward toward the passenger area. This is especially true if the vehicle has been hit broadside and the door has already been pushed inward. If this condition develops, another technique should be tried. Once the door starts to move inward, it is hard to force it back out, making the opening and removal of the door more difficult. Also, the trapped victim may be close to the door, and the pressure could cause the victim further injury. For these reasons, this technique should be used with caution.

Once the gap is created, insert the spreader near the lock. Next, open and close the spreader several inches at a time and work it deeper into the gap. Once the locking mechanism is exposed, advance the spreader tips either above or below the lock. When the spreader is inserted deep into the door, open it, using full power to either break the lock or tear the door from it (see Figures 21-A and 21-B). When the door is open, force it back as far as possible to expose the hinge, using the spreader, a ram, or a come-along (see Figure 22).

If more room is needed, break the top hinge and lay the door on the ground, or break both hinges and remove the door completely. To do this, manipulate the spreader and stand between the door and the vehicle (see Figure 23). Insert the closed spreader either above or below the top hinge and spread until either the hinge or the bolts that attach the hinge are broken. Apply the same procedure to the bottom hinge. **The top hinge should always be broken first** because if the bottom hinge is broken first, the other end of the door will be forced upward creating a hazardous situation.

When a door is being removed completely, a second rescuer should stand to the side of the door

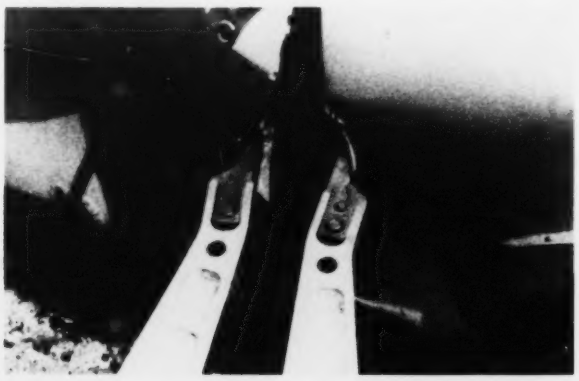

Figure 21-A. Hydraulic Spreader Widening a Gap

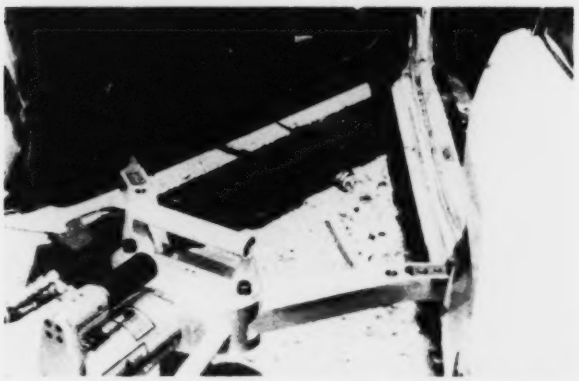

Figure 21-B. Spreader Forcing a Door Opening

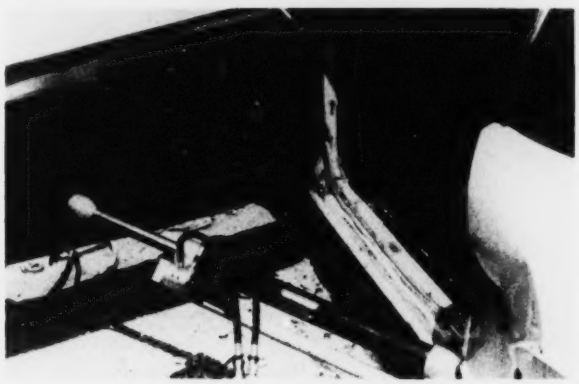

Figure 22. Hydraulic Ram Widening a Door Opening

Figure 23. Breaking a Top Hinge With a Hydraulic Spreader

Figure 24. Guiding Top Frame of a Door

with one hand guiding the top frame and the other hand near the handle, as shown in Figure 24. As the door breaks loose, the rescuer stabilizing the door should direct it toward the ground. He or she should never actually try to hold the door or stand directly in line with it, because when the bottom hinge breaks, the door is often propelled forward with great force.

NOTE: During this procedure the spreader may be forced into the victim area. If this occurs, discontinue the procedure and try another approach.

The most serious problem encountered when using the mechanical or air-powered spreader is the tendency of the tool to lose its grip and jump back with great force toward the operator. This is caused by opening the spreader too wide initially, creating a "V" shape in the metal near the outside edge. This "V" tends to force the spreader out of the opening. To prevent this problem, make smaller initial spreads with the tool and work the tips of the spreader deeper into the opening as the procedure progresses. Once the tips are deep into the opening the tool can be spread to its maximum width.

If the tool fails to maintain a positive grip and keeps popping out of the opening, it is useless to try to manually force or hold the tool in position. Instead, change the angle of the tool either upward or downward, or select a completely new area to work on.

Another problem often encountered while using this tool on a door is that the sheet metal tears away from the lock without breaking the locking mechanism, thus preventing the door from coming free. This is a common problem with the newer light-weight vehicles. When the metal begins to tear, reposition the tool either upward or downward, trying to get it deeper into the opening. If this still does

not correct the problem, the spreader can be inserted between the rocker panel and the lock, and then spread vertically (see Figure 25). This will often shear the metal or lock and free the door. The spreader may also be placed vertically between the roof and the lock and spread vertically to force the door open and shear the metal.

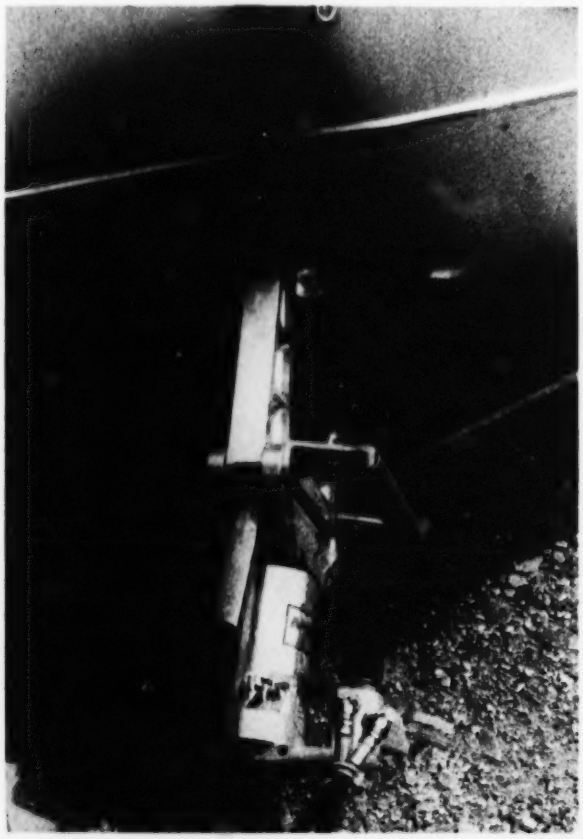

Figure 25. Shearing a Lock With a Hydraulic Spreader

If all of the suggested procedures prove ineffective, an air chisel or a mechanical or air-powered shear can be used to cut the metal from around the lock once it is exposed.

Forcing a Door from the Hinge Side. There are times when it is impossible or impractical to remove a door at the handle. For instance, when the door is caved-in near the handle, attempting to pry it open at the handle will push the door into the interior of the vehicle, possibly creating further injury to the victim. In this situation, the door should be forced open from the hinge side.

To perform this procedure, it may be necessary to make a starter opening. This can be done using the procedure previously explained. Once the opening is made, locate the hinges, which are usually placed toward the rear of the front fender. To expose the hinges, use an air chisel to cut the sheet metal of the fender. Remove enough metal from both the door and the fender to allow the spreader to wedge between the hinges and the main body of the vehicle (see Figure 26). Once the tool is in this position, open it until the hinge or the bolts break. Again, the top hinge should be broken before the bottom hinge. After breaking both hinges, use the spreader to push the door open. If additional room is needed to get to the victim, use the hydraulic ram to push the door open.

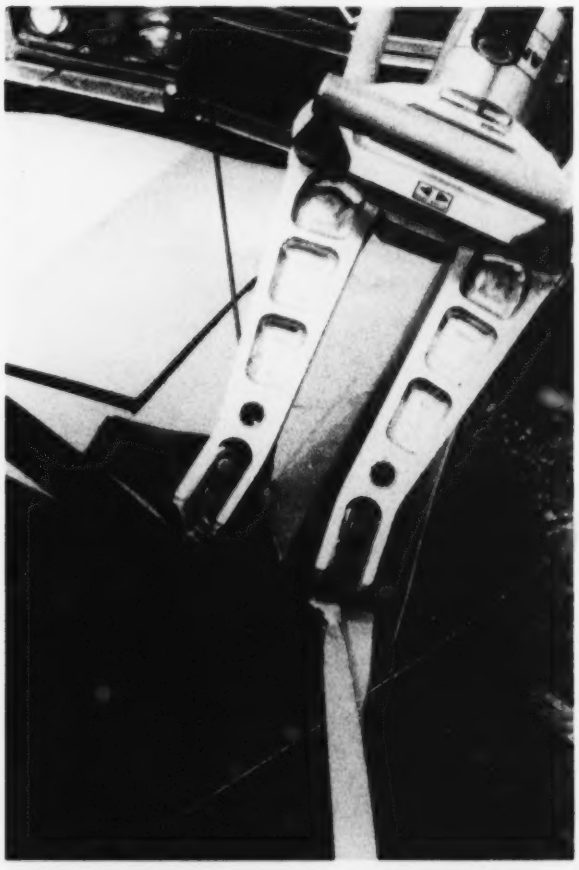

Figure 26. Metal Removed to Position Spreader

If a problem is encountered when trying to position the tool between the hinge and the main body of the car, position the tool between the top of the door and the roof and as near to the front of the door as possible. Open the spreader until the door is pushed downward and outward, exposing the top hinge (see Figure 27). The tool can now be placed in this space, just above the hinge. Open the tool until the top hinge is broken; then move it downward to the bottom hinge and repeat the procedure.

Figure 27. Hydraulic Spreader Exposing Top Door Hinge

When trying to break or remove a door hinge, always position the tool as close to the hinge as possible, directing all the force to one hinge. It is also possible to place the tips of the spreader inside the hinge and break the pin on which the hinge pivots.

Cutting the Door Pin

Sometimes it may be necessary to cut the exposed door's latching pin or support if the sheet metal from around the latch has been torn by the spreader tool. This procedure may also be used if the spreader fails. To perform this procedure cut either the support post or the latch pin with a heavy pair of bolt cutters, an air chisel, or a hydraulic cutting shear (see Figures 28-A and 28-B).

If an air chisel is used, it must be capable of operating at 300 psi. It must have a sufficient pressure and volume of air to cut heavy pins. When using the hydraulic cutting shears, follow the manufacturer's recommendations for cutting applications when working with case-hardened steel.

Figure 28-A. Door Pin Cut

Figure 28-B. Latch Pin Cut

WINDSHIELD REMOVAL

Often during extrication procedures the windshield of a vehicle will have to be removed before procedures such as removing the roof, pulling the steering column, and rolling the dash can be accomplished. Windshields are made of laminated glass (two layers of glass with a plastic sheet in between) to prevent them from shattering and popping out upon impact. Windshields are usually installed in a rubber seal in the windshield frame or sealed in place with a tough caulking compound.

When removing the glass, always cover the victim with a salvage cover or an aluminized blanket. Regular blankets do not provide sufficient protection and should not be used.

A windshield in a rubber seal can be removed by cutting the seal and either applying slight pressure against the glass from the inside of the vehicle, or

prying the glass outward with bale hooks or small pry bars. The glass will usually pop out in one piece (see Figure 29).

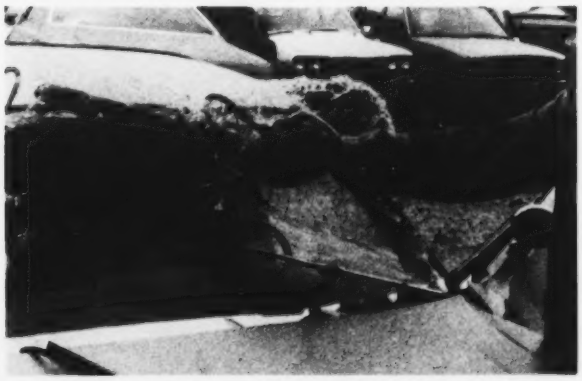

Figure 29. Pulling a Windshield With Bale Hooks

When windshields are set in caulking, several removal procedures can be used. After the trim pieces are removed, the caulking can be cut with a windshield-removal tool or a bale hook (see Figure 30). This procedure is easier when the air temperature is warm because the caulking becomes more pliable. The entire windshield should be removed in case more than one rescue procedure has to be carried out. Another way to remove a windshield set in caulking is to use an ax to chop the glass out around the edges.

Figure 30. Removing Windshield Trim

Making an Opening to Pull a Steering Column

If it is necessary to rapidly pull off the steering column, the rescuer may choose to chop a hole in the glass directly above the column (see Figure 31), drop a chain through the hole, and attach the chain for the pull without removing the entire windshield. Even though this may be rapid, it is not recommended if another technique can be used.

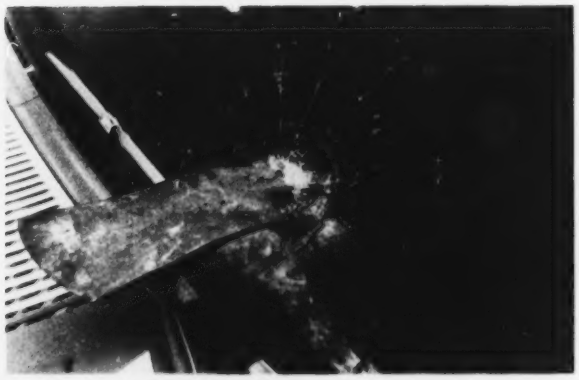

Figure 31. Making a Hole in a Windshield

Air bags can also be used to remove a windshield. Place a long narrow bag on the dash and a smaller narrow bag between the dash and the longer bag (see Figure 32). Inflate the smaller bag first, bringing the long bag in contact with the curvature of the windshield. As the long bag is inflated, the windshield will pop out. It is important to monitor the movement of the dashboard and how this movement affects the victim (see Figures 33-A and 33-B) during this procedure. Once the windshield is removed, rescue procedures can be completed.

Figure 32. Placement of Air Bags Prior to Windshield Removal

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Figure 33-A. Air Bag Placed on Dashboard

Figure 33-B. Windshield Removed With an Air Bag

STEERING COLUMN REMOVAL

Head-on accidents often result in a driver being pinned under the steering column. This victim may suffer severe chest and abdominal injuries and may need to be extricated quickly. Several methods can be used to free a victim pinned by a steering column.

As with any other rescue procedure, the simplest approach is sometimes the best. First, try sliding the seat back by using the seat release mechanism. If it is not jammed, this will more than likely provide enough room to relieve any pressure on the victim. If the vehicle has a tilt-wheel mechanism, try to operate it and move the steering wheel forward to gain more space. If these methods do not provide enough room, initiate other procedures.

In some situations, portions of the steering wheel can be cut away to provide additional room. A variety of tools can be used to complete this task, such as a hacksaw, bolt cutters, a reciprocating saw, or air- or hydraulic-powered shears. The position of the victim will dictate the possibility of successfully using this procedure. Before cutting the steering wheel, secure it to prevent it from vibrating or rotating into the victim.

Pushing the steering column away from the victim is usually the fastest way to move it away from the victim's body, since the windshield does not usually have to be removed to do this. Tools used for this operation may include a porta-power, jacks, and a air- or mechanically-powered ram unit.

To perform this procedure, place the jack or ram at the base of the column at the dashboard, and then secure it at the base of the front seat frame (see Figure 34). Before extending the ram, build a box crib under the frame of the vehicle at the base of the jack or ram to compensate for the lack of

Figure 34. Placement of Hydraulic Ram and Cribbing

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strength in the newer unibody-constructed vehicles. Extend the jack or ram to push the column out of the way (see Figure 35).

Figure 35. Hydraulic Ram Extended to Move a Steering Wheel

Pulling the Steering Column With a Come-along

Pulling the steering column with the come-along is probably the method most frequently used. A two-ton, heavy-duty come-along, a set of puller chains, cribbing, and a roller block will be needed for this procedure.

First, remove the windshield to allow a direct pull to the front. Next, place a chain low on the column and wrap it around the column at least once (see Figure 36). Bring the chain upward from under the column through the wheel (see Figure 37). The pull is made from this point. Attach another chain to the front frame and bring it up around the front of the vehicle. Place the come-along as close to the front edge of the vehicle as possible (see Figure 38). Then, extend and attach the cable to the chain around the column.

Figure 36. Chain Placed Low Around Steering Column

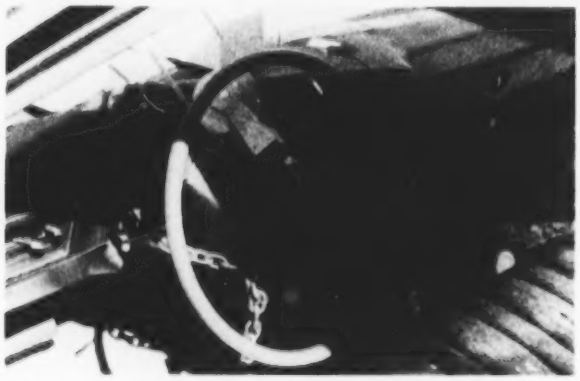

Figure 37. Chain Placed Over Steering Wheel Hub

Figure 38. Come-Along in Place

Next, place cribbing under the chain in the front of the vehicle to prevent the chain from digging into the sheet metal. Place cribbing along the path of the cable and place a roller block, approximately six inches in diameter, on top of the cribbing to provide lift and a smooth path on which the cable can run (see Figure 39). Tighten the cable and pull the column upward and out of the way.

It is usually safer to pull the handle of the come-along into a horizontal position so the handle can be operated with the rescuer's back facing the steering column (see Figure 39). In some situations, it may work better to place the stationary part of the come-along on the opposite side of the hood and pull the wheel diagonally. This position helps protect the rescuer in case the cable breaks, and also gives better leverage.

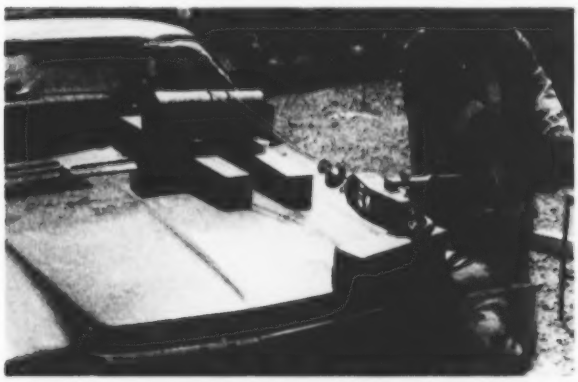

Figure 39. Cribbing and Roller Block in Place

The rescue personnel stationed with the victim should signal the operator of the come-along when the wheel has been moved far enough to free the victim.

Pulling the Steering Column Using the Porta-power

A porta-power can also be used to pull the steering column after the windshield is removed. It is necessary to use this procedure when a vehicle does not have a hood, or when a vehicle, such as a van, has little or no front-end assembly.

When using the porta-power, attach the flat base and pull plate to the ram. Position a long piece of 4" x 4" wood support (preferably oak) from the roof down to the hood. The porta-power should be placed with the base plate squarely on the piece of 4" x 4" (see Figure 40). Attach a chain to one end of the

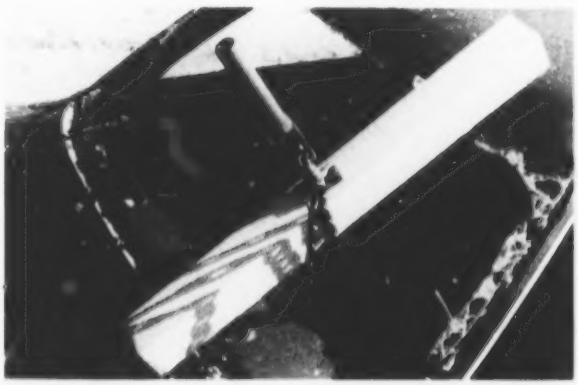

Figure 40. Position of Porta Power for Steering Wheel Pull

pull plate, running it down and around the steering column, and then back to attach to the other end of the pull plate. Extend the porta-power to move the pull plate away from the steering column and pull the column upward.

The length of the ram travel will dictate the distance the column can be moved. The ram will have to be retracted several times to move the column completely out of the way. Lay a short piece of chain with two grab hooks over the piece of 4" x 4" above the porta-power baseplate to eliminate any loss of travel of the column. When the ram is fully extended, attach the grab hooks to the chain around the column to prevent the column from moving downward. Retract the ram, adjust the column chain in the puller plate, and extend the ram again to pull the column further. Repeat this procedure until the column is out of the way.

Pulling the Steering Column With Air Bags

Air bags provide another means of removing a steering column to free a victim. Remove the windshield to allow sufficient room to work and to prevent the cutting of the cargo straps used with the air bags.

Lay two large air bags on top of each other on the hood near the windshield. Run a nylon cargo strap over the front of the hood and under the vehicle, wrap the strap once around the frame or front axle, and bring it back up on the hood. Then wrap it once or twice around the steering column, and attach it to the ratchet mechanism of the strap. Operate this ratchet mechanism until the strap is secured as tightly as possible over the air bags.

Inflate the bottom air bag first, follow this step by inflating the top air bag until the steering column is moved the desired distance. It may help to inflate the bottom bag only one-half to three-fourths full, so that the top bag will sink slightly into the bottom bag, thus creating more stability.

A problem with using air bags to pull a steering column occurs if the hood is distorted and not level; this condition makes it difficult to keep the air bags in position.

Pulling the Steering Column With a Hydraulic Spreader

To pull the steering column with a hydraulic spreader, remove the windshield and place a chain low around the steering column. On a vehicle equipped with a tilt wheel, the chain should be attached below the tilt joint to prevent the wheel from completely breaking off when pressure is applied (see Figure 41). Only chains that are rated for the tool being operated should be used in this operation.

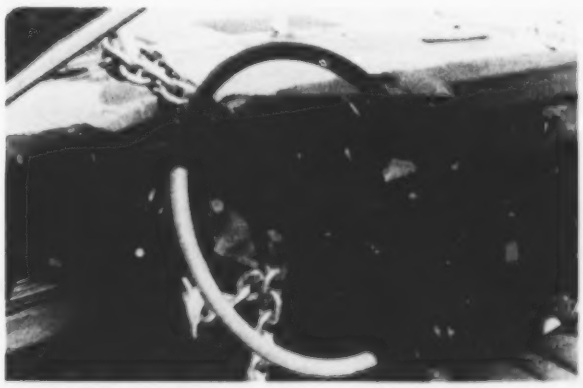

Figure 41. Position of Chain on Steering Column

Next, attach a chain to the front of the vehicle. Fasten the hook end of the chain to the front axle or frame of the vehicle. Do not attach the chain to the front bumper or to a weak support member such as a tie rod. A quick method for securing a cable or chain to the front end of the vehicle is to lay the chain or cable over the top of the front wheel, then reach under the car and attach the chain or cable so that the entire front suspension is encircled (see Figures 42-A and 42-B). Lay the free end of the chain on the hood for attachment to the spreader.

Next, set the hydraulic spreader on the hood with the arms fully opened. Attach the chains to the spreader arms, using a set of grab hooks.

Figure 42-A. Placing Chain Over Top of Front Wheel

Figure 42-B. Chain Around Entire Front Suspension

Attach the chain from the steering column [illegible]t. Try to keep the spreader as close to the steering column as possible (see Figure 43). Then, attach the chain from the front; this will allow a more direct pull (see Figure 44).

Next, operate the tool and close the spreader. Pull the steering column as much as needed to free the victim. If completely closing the spreader does not allow enough space to free the victim, open the spreader completely and reattach the chain. Close the tool again, further pulling the steering column.

Figure 43. Hydraulic Spreader Positioned on Hood

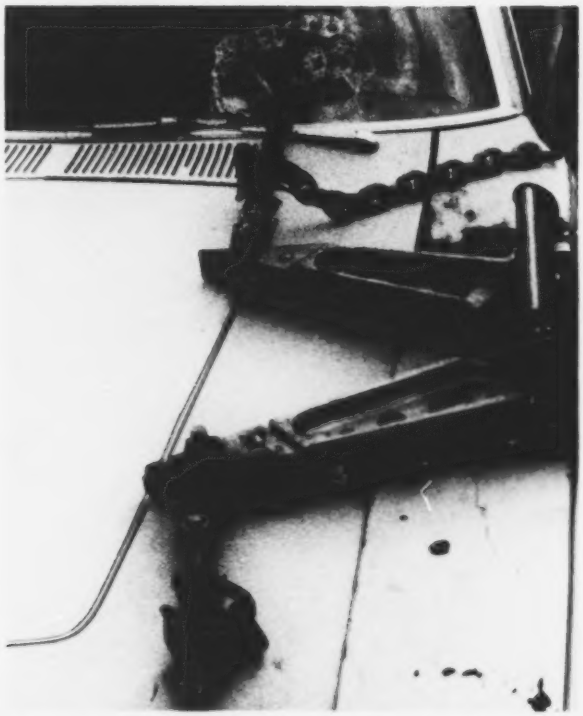

Figure 44. Spreader Positioned on Hood With Chains Attached

CAUTION: When the spreader is opened to slacken the chain, the steering column will drop backward three or four inches toward the victim. Allow space for this drop.

Note that this adjustment in the chain is often necessary when a vehicle has a severely buckled hood. The first pull usually results in flattening the hood rather than pulling the wheel. It may be helpful to place pieces of wood support (4" x 4" cribbing) under the chain near the front of the hood and on the hood near the steering column (see Figure 45). Use of the roller block described earlier can also be advantageous.

Pulling the Steering Column With Hydraulic Rams

Some hydraulic rams can be used as pulling devices. To remove a steering column, with a hydraulic ram, first remove the windshield. With the anchor and column chains in place, place the ram on the hood with the base anchored at the front of the vehicle (see Figure 46). Extend the ram and attach it to the column chain. Pull the column by retracting the ram (see Figure 47).

Figure 45. Wood Supports in Place Under Chains

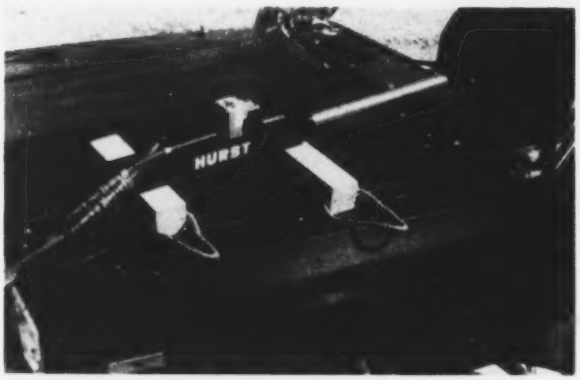

Figure 46. Hydraulic Ram Positioned on Hood

Figure 47. Steering Column Pulled Using Hydraulic Ram

Pulling a Steering Column on a Front-Wheel-Drive Vehicle

The steering column on a front-wheel-drive vehicle can consist of as many as four sections. This type of column can break off or not move if the chains are not attached low enough to secure the bottom half of the column. It may be necessary to actually punch a hole through the dashboard at the defroster vent to wrap the column as low as possible. When pulling the column, secure it as low as possible to get maximum lift.

There is no one method for removing a steering column. As vehicle construction changes, extrication methods have to be adjusted.

ROOF REMOVAL

Occasionally, the roof of a vehicle must be removed to provide better access to and removal of a victim. Hacksaws, reciprocating saws, air chisels, and hydraulic cutting shears can be used to make cuts in the vehicle's roof so it can be moved out of the way or removed.

When removing a roof, remove the windshield first. Make cuts in the windshield support pillars (see Figure 48). Then make cuts in the center support pillars, and finally at the edge of the roof just forward of the rear support pillar (see Figures 49-A and 49-B).

The rear pillar may have to be cut for complete roof removal; however, this is time-consuming and usually unnecessary. The rear roof support pillar is sometimes wide, and it is necessary to make two or three cuts for complete removal of the roof (see Figure 50). To accomplish this, cut in front of and behind the pillar. It may be necessary to make an additional cut in the middle to complete the procedure. Cutting the rear pillar should be avoided if at all possible.

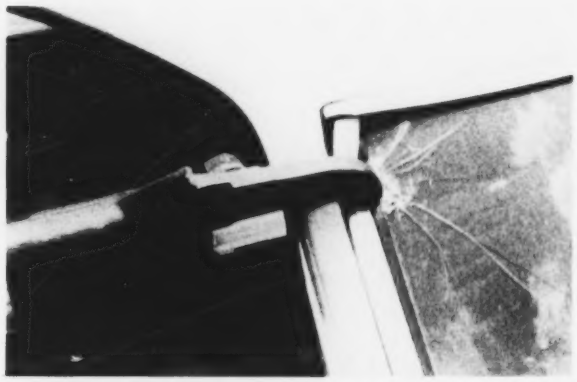

Figure 48. Cutting Windshield Support Pillars

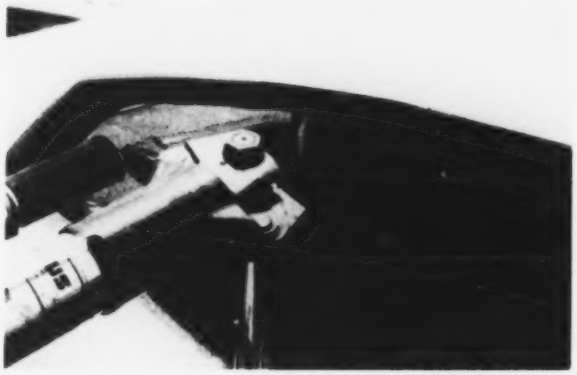

Figure 49-A. Cutting Center Support Pillar

Figure 49-B. Cutting Front of the Rear Support Pillar

Figure 50. Additional Cuts in Rear Support Pillar

When cutting the rear pillar of a vehicle with a hatch-back, the rescuer needs to be aware of the danger associated with the spring-loaded hatch. If the pillar and rear hatch are cut at the same time, the spring-loaded section of the hatch may unexpectedly fly open, causing injury to nearby rescuers.

The exposed ends of the cut pillars present another potential hazard. It may be helpful to have sections of old fire hose available to slide over an exposed pillar to prevent injury to the victim and the rescuer.

After the cuts are made, the roof must be folded out of the way. This can be achieved in two ways; using a ram or by using a come-along.

Using a Ram

Place a ram at the front of the car in the front doorjamb near the hinges (see Figure 51). Place the base on the rocker panel and extend the moving end to the edge of the roof. If the door is in place,

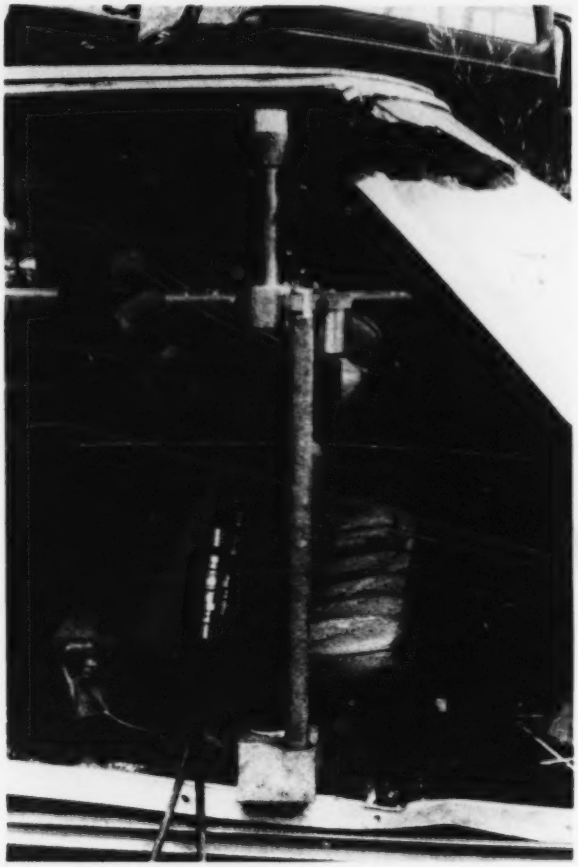

Figure 51. Ram Positioned to Raise the Roof

the top edge of the door can be used to support the base of the ram. This should not be done if the victim is positioned near the door.

To further stabilize the rocker panel, it may be necessary to place a box crib under the ram, especially on unibody-constructed vehicles. The integrity of the unibody construction is compromised when the pillar is cut, thus causing the vehicle to bend down in the middle when force is applied to the rocker panel area.

As pressure is applied by the ram, it is necessary to make a crease in the sheet metal of the roof by placing a bar or long piece of cribbing across the roof and applying pressure downward in the area of the rear cuts. Striking the roof is unacceptable due to the noise it causes and the possibility of moving the vehicle. It may not be necessary to use a ram to lift the roof; however, using one will reduce the possibility of injury to the rescuers.

Using a Come-along

Another method of folding back the roof is to pull the roof with a come-along. To do this, secure an anchor chain on the frame at the rear center of the vehicle. Place the come-along on the trunk lid and attach it to the anchor chain as close to the frame as possible on a vehicle without a trunk. Secure a second chain around the front support pillars. Extend the come-along cable and attach it to the center of the front chain (see Figure 52).

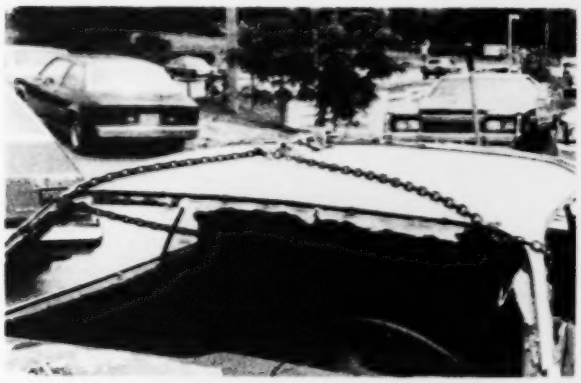

Figure 52. Chain Positioned With Come-Along

Two 4" x 4" x 3' pieces of cribbing should be stacked on the roof at the rear cuts under the come-along cable. As the cable is tightened, apply pressure downward in the cut area at the rear of the vehicle while lifting the front end upward and folding the roof back (see Figure 53).

Figure 53. Folding a Roof Back

MOVING THE DASHBOARD

When a vehicle is involved in a high-speed collision, the force of impact is usually so great that the size of the passenger area is often reduced significantly and the shape is drastically changed. At times the engine, front axle, and front tires may be driven into the front passenger compartment, severely trapping the victim between the dash and the seats. In these situations the skill of rescue personnel and their knowledge of rescue procedures will be greatly challenged.

Many times victims will be found totally enclosed in twisted and bent metal. It is imperative to reach these victims quickly and initiate life-saving measures immediately.

Initial rescue procedures with this type of accident include removing the roof, doors, and windshield. These procedures will provide sufficient access to the victim for patient care.

The victim can be trapped by many objects, such as the dashboard, steering wheel, gear shift lever, brake pedal, and accelerator. With extensive entrapment the dashboard will often have to be completely displaced. It should be rolled upward and off the victim for safe removal.

A dashboard roll-up will involve the use of several tools, such as a porta-power, a hydraulic ram, a come-along and chains, hydraulically-powered shears, and hydraulic spreaders. When rescue personnel are involved in this type of operation there must be good communication between everyone involved.

Initially, deep cuts are made in the front door frame just above the rocker panels on both sides of the vehicle, (see Figure 54). This is done with the

Figure 54. Rocker Panel Being Cut

hydraulically-powered shears or an air chisel, using a half-moon chisel. The cuts need to be as deep as possible in order to weaken the dash and the firewall framework.

Next, place manual or mechanical hydraulic rams in the door frames with the base plates on the rocker panels and the traveling ends placed in the upper door frames between the top hinges and the curvature of the windshield pillar (see Figure 55). Place a box crib under the rocker panel. Try to place it directly under the base of the ram to provide stability to the rocker panel and prevent it from being pushed downward.

Figure 55. Hydraulic Ram Moving the Dashboard

There will be times when the rams will not fit properly in the door frame or a solid area will not be available to secure the base of a ram. To overcome this problem, open the hydraulic spreader or the hydraulically powered shear and clamp it onto the rocker panel at the base of the ram to provide a stop for it to rest against (see Figure 56).

Once the rams are in place, extend them to push the dashboard and firewall upward out of the way. As the dashboard moves, additional cuts may have to be made in the area of the initial cut to further weaken the support metal. Rescuers operating the tools must communicate with the rescuers closest to the victim, because as the dashboard moves, it can cause further injury to the victim.

If rams are not available or cannot be used due to the structure of the vehicle, use a come-along or the hydraulic spreader to pull the dashboard. This is accomplished by attaching the come-along on the hydraulic spreader to the steering column. The entire dashboard will move as the steering column moves upward.

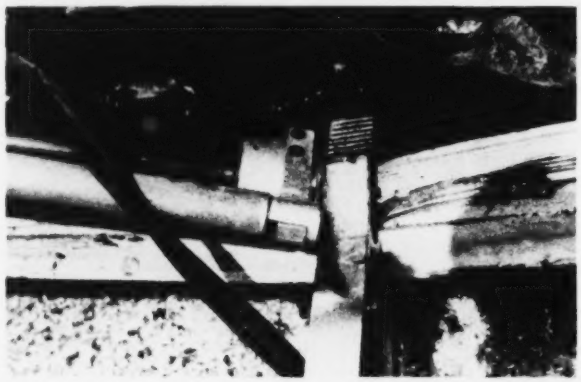

Figure 56. Using the Hydraulic Spreader as a Clamp

Moving the dashboard may not be enough to free the victim of the tangled mess of all the surrounding plastic and metal. If this is the case, rescue personnel may have to use additional smaller hydraulic rams or hydraulic spreader tools to free the victim's extremities.

SPECIAL EXTRICATION PROCEDURES

It may be necessary to remove or displace the seats of a vehicle to free a victim. This can be accomplished by using hand tools such as wrenches, screwdrivers, pry bars, and hand or air ratchets with sockets. In addition to these tools, devices such as the come-along and chains, and manual or mechanically-powered hydraulic rams or spreader tools can be used.

When working in a two-door vehicle it is often necessary to make more room to remove a victim trapped in the rear seat. The simplest procedure is to remove the backs of the front seats. First, locate the outer pivot area of each front seat; then remove the plastic or chrome cover to expose the mechanism that holds the seat in place (see Figure 57). This mechanism will be a pin with a snap-ring fastener or will be bolted in place. Remove the snap-ring or bolt that holds the back of the seat and pry the pivot arm off the pin to free the seat from the outer mechanism (see Figure 58). Lift the back of the seat upward and forward to remove it completely from the inside holding mechanism. The inside pivot is

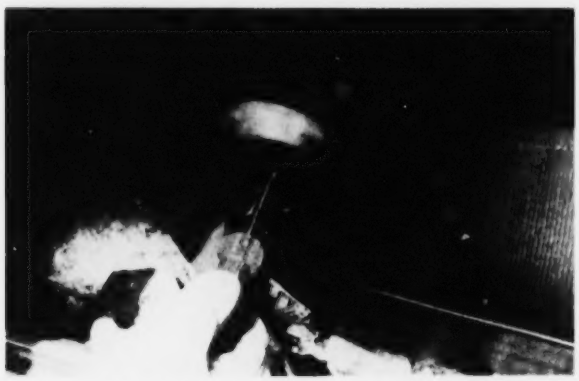

Figure 57. Removing Cover to Expose Seat Mechanism

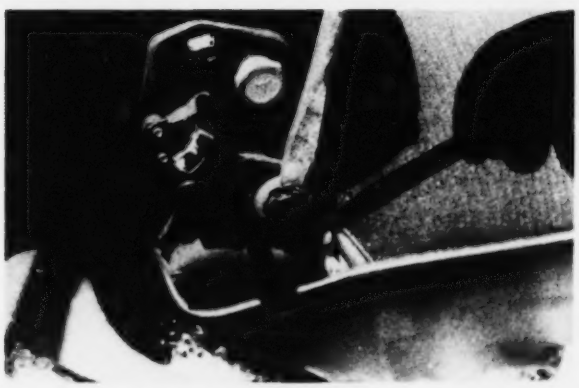

Figure 58. Removing a Snap-Ring

usually held by a "J" shaped hook located at the base of the seat back.

Once the back of the seat is removed, in most cases there will be enough room to access and remove the victim (see Figure 59). This method of seat-back removal should also be used to free a victim trapped between the front seat and the dashboard. Remember, the victim's cervical spine must be immobilized with a short spine-board device.

In some situations the pivot arms can be cut with an air chisel, using a half-moon chisel bit, or the mechanical hydraulically-powered shears. This may provide more rapid access and removal of the victim.

It may be possible to remove the entire seat by unbolting it from the floor. Even when there is only minor damage to the vehicle, this is the correct way to remove a victim from the rear seat. To do this locate and remove the floor bolts using a wrench or a socket and ratchet. Using an air ratchet will speed

Figure 59. Front Backrest Removed to Access Backseat

the operation. Once the victim is safely removed, the seat can be replaced without damaging the vehicle.

When working with a four-door vehicle it may be necessary to remove or displace a seat by pulling it with a come-along and a chain. Seats can be pulled either forward or backward, depending on the location and position of the victim. When pulling the seat forward with the windshield removed, anchor the come-along in the same manner as when pulling the steering column. Wrap a chain around the base of the seat, extend the cable of the come-along through the windshield, and attach the cable to this chain. Tighten the come-along cable, using the roller block on the dashboard and the hood, and pull the seat from the adjustment track. In some vehicles, it may be necessary to cut the adjustment spring before the seat can be completely removed. For complete access, both sides of the seat will have to be pulled off the track.

This procedure can be done in reverse through the rear window when a victim is trapped between the front seat and the dashboard (see Figure 60). Again, the victim must have cervical-spine immobilization before this procedure is attempted.

In other circumstances the seat can be pushed forward or backward with the manual or mechanical hydraulically-powered ram or the large spreader tools. This should be done only after the victim has had cervical-spine immobilization. First, locate the metal base frame of the seat and push against this area for maximum movement. Secure the spreader or base of the ram against the door frame just above the rocker panel and either in front of or to the rear of the seat, depending on the direction the seat needs to moved (see Figure 61). At times cribbing will have

Figure 60. Removing Front Seat by Pulling Through Back Window Opening

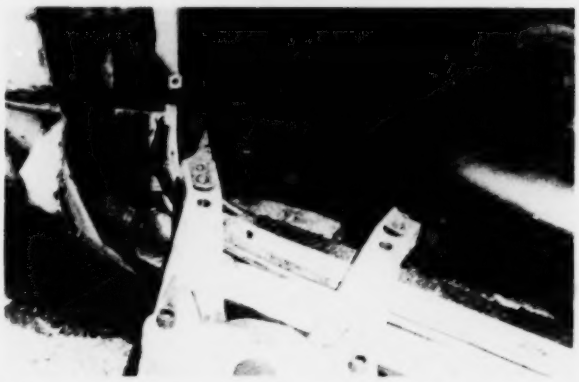

Figure 61. Spreader Secured Against Door Frame

to be used between the tool and the door frame to provide a wider distribution of force. Once the tool is in place, open the spreader or ram and push the seat out of the way.

Seats may also be completely removed with the mechanical hydraulically-powered spreader by placing the spreader between the metal base frame of the seat and the rocker panel (see Figure 62). Open the spreader and remove the seat from the adjustment track. Repeat this procedure on both sides of the seat until the seat can be completely removed from the vehicle. It is important to monitor the downward movement of the rocker panel in unibody-constructed vehicles, as this operation will tend to move the rocker panel when the frame structure has been damaged. To prevent this downward movement, build a box crib under the rocker panel at the point where the pressure of the tool is being applied.

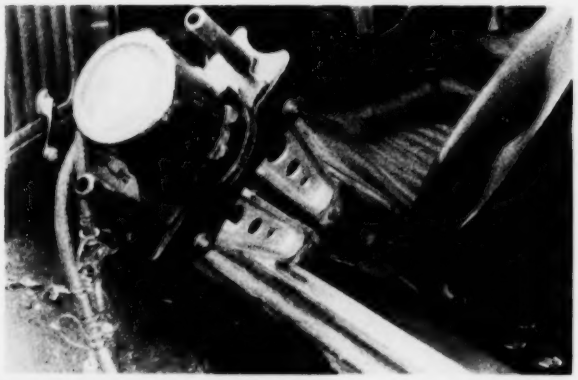

Figure 62. Spreader Placed Between Rocker Panel and the Seat

Accessing and Removing a Victim From a Vehicle on its Side

When rescuers arrive at an accident scene and find a vehicle on its side, stabilizing the vehicle is the first priority. Quick entry for the rescuers providing patient care is best made through the rear window. When a victim is against the rear window, entry will have to be made through the door on the top side of the vehicle. In this case, the door will have to be secured open by a rope, chain, or cable so that it cannot fall onto the rescuers (see Figure 63). This should be done immediately so that evaluation and care of the victim may begin. In this instance, cut an opening in the roof to provide room to care for and remove the victim.

To gain entry through the roof, cut an opening with an air chisel or a can-opener-type hand cutter (see Figure 64). When using an air chisel, use the

Figure 63. Door Secured by a Rope

Figure 64. Cutting an Opening With an Air Chisel

sheet-metal chisel for the roof panel and the half-moon chisel for the heavy support braces. Do not allow the air chisel to cut too deeply when cutting the roof panel, or it may hit the heavy support braces and slow the operation.

To make the opening in the roof, start approximately two to three inches below the top edge of the roof line near the windshield. Make the cut horizontally to the rear of the roof panel and then downward to within an inch of the lower edge. Make another cut down the front edge of the roof from the point where the first cut was started. After making this cut, fold the roof metal downward to form a flat work surface. Remove the headliner with a knife (see Figure 65).

Next, cut the bottom edge of the heavier metal support braces. Once the braces are cut, bend them upward out of the way. Total access to the passenger area is now possible (see Figure 66).

Be aware that the edges of the cut sheet metal

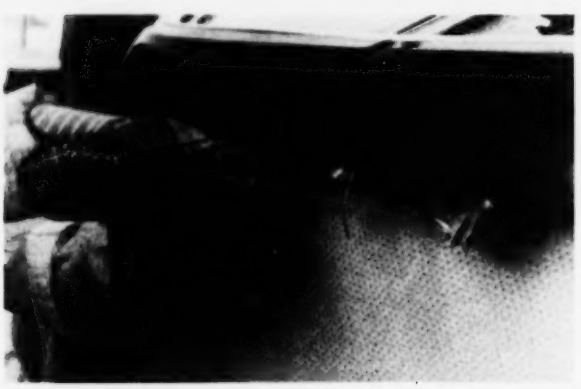

Figure 65. Removing the Headliner With a Knife

Figure 66. Accessible Passinger Area

are extremely sharp. Use pieces of old fire hose along these edges to provide protection to the victim and the rescuers.

It is imperative that during this procedure the victim be continually reassured and protected from further injury. Once the roof opening is made to free the victim, there may be a need to perform other rescue procedures. Perform such rescue procedures with modification in the same manner as with a vehicle upright on its wheels.

CAUTION: Never cut the framework of the roof structure, because when a vehicle is on its side the framework may be the major means of stabilizing the vehicle.

Freeing a Victim Trapped Under a Vehicle

When a victim is trapped under a vehicle that has rolled over or collapsed, the vehicle must be lifted off the victim to prevent further injury to the victim. Lifting can be accomplished by using air bags, hydraulic jacks or spreaders, or winches from tow trucks or rescue vehicles equipped with boom poles (see Figure 67). Victims trapped under vehicles are sometimes severely injured and often inaccessible for medical care. Rescue personnel should first stabilize the vehicle so that no further movement can take place. Once the victim is stabilized, the best method to access the victim should be determined. Rescuers should remember not to act in haste, causing further injury to or even the death of a victim.

Even a vehicle that appears to be in a stable position may move or shift in an uncontrollable manner when it is lifted. It is essential to lift the entire vehicle uniformly. Lifting on one side only may cause the other side to move in the opposite

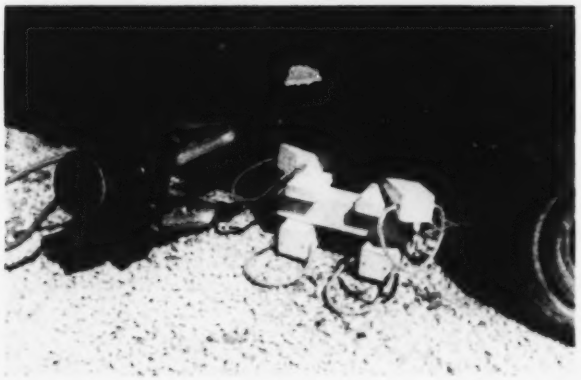

Figure 67. Lifting a Vehicle

direction. To prevent this, try to predict the reactions that will take place when the vehicle is lifted or moved. Any unforeseen movement could further injure or crush the victim.

In most instances, air bags are used as the primary lifting device. Air bags are most effective if they come in contact with flat, smooth surfaces that will distribute their lifting power. To provide smooth surfaces for the lift, place pieces of 3/4" plywood, cut the same size as the air bag, above and below the air bag (see Figure 68). The vehicle must be lifted from two points on each side of the victim to make sure it does not lean or tilt while it is being lifted. If just the front or the rear of the vehicle is being lifted, the wheels must be chocked to prevent it from shifting off the air bags. Box cribs must always be used in conjunction with the air-bag lift as protection in the event of bag failure or slippage. If an air bag does not make contact with the vehicle as the lift begins, place the bag on a solid box crib

Figure 68. Air Bag Used as a Lifting Device

in order to make contact with the vehicle frame When operating the air bag controls, the operator must be in a position to visualize the movement of the bags and to talk with the rescue personnel closest to the victim. This enables the rescuers to make a controlled lift without causing further injury to the victim.

The hydraulic spreader tool may also be used to lift a vehicle off a victim; however, this method is not as efficient or safe as the air-bag system. Before the vehicle is lifted, it is important to predetermine methods of stabilizing the vehicle and removing the victim.

When the hydraulic spreader is used to lift a vehicle, the contact point on the vehicle must be a solid and reasonably smooth frame member. It may be necessary to place a flat piece of cribbing between the vehicle and the spreader tips to provide additional contact area. If working on soft ground, it will be necessary to place on the ground cribbing on which to rest the tip of the spreader so that the load is distributed over a larger area. If this is not done, the spreader may sink into the ground rather than lift the vehicle.

While lifting with the spreader, it is absolutely necessary to use a box crib as a safety device in the event the spreader tool moves out of position. When spreading the tool, build the crib as the vehicle lifts, always maintaining contact with the crib. Wedge-shaped cribbing must be used at the top of the crib to provide continual contact. The 4" x 4" cribbing can be put in place only after the vehicle has been lifted 4 inches. When lifting a vehicle with the hydraulic spreader, follow the manufacturer's recommendations for its operation and control.

Manually-operated hydraulic jacks or air jacks may also be used in lifting operations. Using these jacks is safer than using the hydraulic spreader; however, they are more difficult to operate than the air-bag system. When using these devices, make sure that they are rated for the weight being lifted, and follow the manufacturer's recommendations for safe operation. Make sure the ends of the jacks are in solid contact with the ground as well as the vehicle's surface. Cribbing must always be used as a safety measure when performing lifting procedures.

There may be a situation where using an air-bag system, hydraulic spreaders, or jacks is not possible. In such instances, a tow truck or a vehicle equipped with a winch and boom poles can be used. When the determination to use a winch has been made,

make sure the personnel operating the winch are familiar with its operations, limitations, and potential hazards. A four-point hitch must be used to lift the entire vehicle and control movement in all directions.

When a vehicle is lifted with a winch and all movement is not controlled, the vehicle may slide, twist, or turn in an unpredictable manner.

Winches should never be used to drag a vehicle off a victim's body, but it may be necessary to drag a vehicle from underneath a car or a truck. If dragging the vehicle is necessary, any victim trapped in the vehicle must have a cervical-spine immobilization, and a rescuer must stay with the victim during all procedures.

When a vehicle rolls and ends up on its roof, remember, it is important to stabilize the vehicle with cribbing. Rescuers should never attempt to open the doors or enter the vehicle before the cribbing is in place, since closed doors give support to the structure of the vehicle. Removing a door, moving a steering-column, removing a windshield, and other disentangling procedures can be performed with the vehicle upside-down by using the procedures previously discussed.

If the roof has completely collapsed, the vehicle will have to be lifted before the victim can be accessed and removed. In such a situation, since it will not be possible to closely monitor the victim's condition, the cautious use of the air-bag lifting system is recommended. This process should be done slowly and monitored closely.

Dealing with Objects Penetrating a Victim's Body

In violent crashes, gearshift levers, brake pedals, mirrors, door handles, or plastic trim may be forced into a victim's body. When this occurs, use extreme caution in attempting to extricate the victim. The victim may appear to be free, but the rescuer should always palpate the victim completely to be sure nothing will prevent the victim's removal. When an object is penetrating the victim, take great care not to remove the object and cause further injury.

Cut the object **after it has been secured** to the victim. Penetrating objects can sometimes be cut with something as simple as a pocketknife; in other cases the procedure may require the use of a hydraulically-powered cutter.

Whatever tool is used, secure the object in the victim's body before cutting, in order to minimize vibration, heat, and movement. Safe removal will depend on the rescuers working as a team and having a variety of tools available.

Removal of the Victim

Once the victim has been disentangled, he or she can be removed from the entrapment situation. The victim's airway should be secured and the cervical-spine immobilized by this time, but before removal another assessment of these patient care concerns should be completed. Do not remove the victim until the cervical-spine is completely and totally immobilized unless there is a life-threatening condition present. Life-threatening situations will fall into one of three areas: airway management, bleeding, or shock. When these conditions cannot be stabilized, rapid removal with cervical-spine consideration of the victim is essential.

Rapid Removal of a Victim

When rapid removal is necessary, slide the victim onto a long backboard with manual stabilization of the cervical-spine. A minimum of four rescue personnel is necessary for safe, effective removal by this method.

Removal should be accomplished with one person securing the head and neck, two people securing the torso and legs, and one person supporting the backboard. Bring the backboard in close to the victim; if possible, slide it underneath the victim. The rescue personnel should secure the head, torso, and legs, working together on the command of the person at the head. Once the body is secured lift and slide the victim onto the backboard, supporting the cervical-spine and keeping the airway open. This procedure can only be learned through training and continued practice.

It must be emphasized that rapid removal is acceptable only when the victim's life is in jeopardy. It is not to be used as a routine procedure.

Standard Victim Removal

When the victim's condition is stabilized and not life-threatening, the rescuer must take the time and effort to assure the victim's condition is not worsened by the removal process. This is done by properly assessing the situation and each victim in the accident by mechanisms of injury (Table 1), and not necessarily by what the victim tells the rescuer personnel. Always treat for the worst possible injuries.

Table 1. Injury-Producing Mechanisms

MECHANISM	POSSIBLE INJURY
Bent or collapsed steering wheel	Head, facial, spinal, chest, arm, shoulder injury
Broken windshield	Head, facial, spinal, arm, shoulder injury
Damaged dashboard	Head, facial, spinal, arm, leg, knee injury
Broken or bent inside door and/or window handles	Penetrating wounds, fractures, dislocations
Seat belts in place	Pelvic, spinal, injury, abdominal trauma
Shoulder belts in place	Chest injury, clavicle, arm fracture, throat trauma
Fire and/or smoke	Inhalation injury, burns
Chemical spills	Inhalation injury, burns, poisoning
Ruptured batteries	Burns

Cervical-spine immobilization devices should always be applied properly (see chapter on patient care and handling). No victim should be removed without being immobilized unless his or her injuries fall into one of the life-threatening categories.

Due to the fact that most victims are in confined spaces, and normal splinting devices cannot be applied until they have been moved, fractures should be stabilized by binding body parts together.

Remember that when removing a victim from an accident, textbook patient-care procedures may not be possible. Do not get caught up in trying to make equipment work in a situation for which it was not designed. Modification of routine procedures and improvisations may be necessary due to the circumstances of the accident.

Once the victim is out of the vehicle, a thorough reassessment should be done, followed by routine patient-care procedures.

Car-Seat Immobilization

When dealing with a child in a car seat, it may be to the child's best interest to immobilize it in the car seat before removing it from the vehicle. This will prevent possible further injury to the child and provide for a safe means of transportation to the hospital. Car seat immobilization is used only when the child is found in the seat and there are no signs of breathing or circulatory compromise.

To secure the child in the car seat, towels, tape and a backboard strap are needed. Towels should be rolled and placed on each side of the victim (see Figures 69-A and 69-B). To secure the head of the

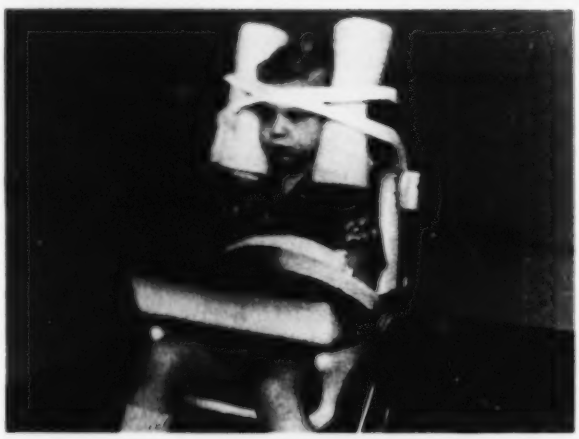

Figure 69-A. Securing a Child in a Car Seat

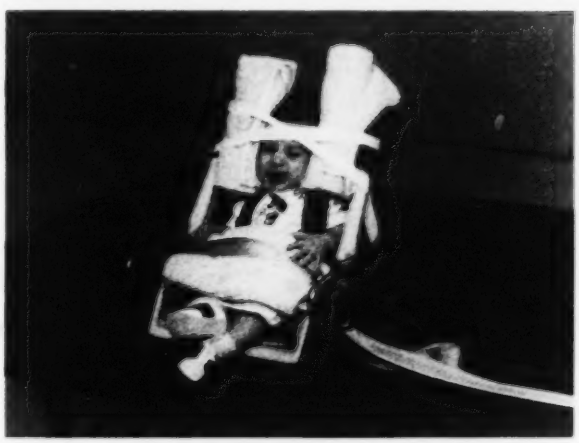

Figure 69-B. Securing an Infant in a Car Seat

victim, place 1" or 2" tape across the forehead and, for added security, across the upper lip below the nose. Secure the body by leaving the car seat straps in place and adding a backboard strap around the car seat at the victim's waist; use a towel or small pillow as padding. Care should be taken that the victim's breathing is not obstructed. Once these steps have been performed, move the victim and the seat into the rescue vehicle.

If the victim has any breathing or circulatory distress, remove the victim from the seat, keeping the head, neck, and back aligned, and secure him or her to a pediatric or adult backboard. Use towels and blankets as padding to secure the victim. Pediatric patients often will suffer head injuries; however, they do not always exhibit any visible indications. The rescuer must treat by the mechanism of injury and not necessarily by the signs and symptoms present.

SPECIAL EXTRICATION SITUATIONS

Extrication from Buses

Even though buses are built by different manufacturers, they can be classified as to their principle use, seating arrangement, and suspension. The main types of buses are school buses, transit buses, and over-the-road buses.

School buses are constructed with a series of horizontal and vertical beams covered inside and out by a metal skin that is fastened on both sides by rivets or sheet metal screws. The seats are bench-type with a removable cushion and are secured by legs that are bolted to the floor on the aisle side and bolted by the frame to a horizontal beam on the opposite side.

A transit bus has the same type of beam construction as a school bus and the same type of seats fastened in the same way. In contrast to a school bus, however, a transit bus is usually constructed with an air-suspension system.

An over-the-road bus has a beam type construction similar to a transit bus. The seats are individual, but each pair shares a common leg. Seats are separated by an arm rest. Each seat is fastened to the bus by legs that are bolted to the floor on the aisle side and in the middle of the seat. The frame of the window seat is bolted to a horizontal beam located in the side wall of the bus. These buses have an air-suspension system to reduce sway and provide a smoother ride on long trips. To perform a safe and efficient rescue operation involving extrication from buses, rescuers must be able to recognize the hazards and problems that may be encountered in a bus accident.

The air-suspension system used on buses can present a hazard to rescuers during rescue operations. The air-suspension system actually holds the carriage off the frame with a cushion of compressed air. If this suspension system fails due to an accident or a fire, the carriage of the bus will settle on the frame, leaving only a few inches between the bottom of the bus and the ground. In most cases, the bus will settle instantly when the air suspension system fails. This system consists of a rubberized bellows at each wheel (see Figure 70).

Figure 70. Closeup View of Suspension System Illustrating Rubberized Air Bellows

If a victim or a rescuer is under the bus or in the engine compartment when the system fails, the chances of being trapped and severely injured are high. Upon arrival at the scene of an incident involving a bus with an air-suspension system that has not failed, the bus should be cribbed immediately to create a stable platform for rescue operations and to prevent it from settling.

Some problems common to accidents involving buses are:

- Limited access
- Narrow aisles and a confined area in which to work
- Lack of lighting, especially for night operation
- Lack of ventilation
- Possibility of a large number of victims with varying degrees of injury
- Possibility of a large fuel spill

School buses and over-the-road buses usually have one main entry door, one emergency exit door, and several windows. Transit buses usually have two doors. If a bus other than a transit bus is damaged so that the main exit is rendered unusable, the access points will have to be the emergency exit door or the windows. If a bus has rolled on its side, there will be only two entry points at ground level, the front and rear windows. If the bus is on its wheels and the main entry is unusable, rescue operations can be performed from above ground.

Using the windows as the point of access or exit can present problems. If the windows are hinged at the top, they will have to be tied open. Some buses have pop-out windows that can be removed, but most school bus windows slide down only part way. If the bus is on its wheels and the normal entry points are not usable, rescue operations must be performed above ground level in a confined area using ladders. It is important to maintain communications from the ground to the inside of the bus.

Forcible entry through the side of a bus requires considerable work. The heaviest beams in a bus are located at the floor where the seats are bolted to the wall, and above and below the windows. Since most seats are located so the passengers can look out the windows, if the metal skin of the bus is cut away between the beams under the windows, the seat will be in the way. Once a seat has been removed, additional cutting of heavy beams will be necessary to create an adequate access point. Before any main beams are cut, the bus must be cribbed into position. If the bus is under stress, cutting the main beams can cause it to settle or move.

The metal skin of a bus is usually fastened by rivets or screws, but may be welded. The fastest way to remove the sheet metal skin of a bus is to cut the heads off the rivets or screws using an air tool with a flat chisel, and then remove a whole panel at one time. Cutting the rivets or screws leaves a smooth surface so rescuers can work.

Using an air chisel creates a high level of noise inside the bus. All of the dirt and dust collected in the overhead racks is knocked free by the vibration. It is important that when the inner metal skin is being cut free, someone is inside the bus at the location of the cutting to make sure that protection is provided to victims and that the cutting will not cause further injury. The victims will have to be prepared for the high noise level and the vibration caused by the cutting.

The narrow aisles in buses create a limited space in which to work. Some stretchers and spine boards are too wide to fit in the aisles and must be placed on the top of seat cushions or across the top of the backs of the seats. Depending upon location of the victims, seat removal for additional working space may not be practical. When seat removal is desirable, the method of removal must be determined. If a seat is pulled free with a come-along or hydraulic spreader, the path the seat takes when it breaks free can be controlled only by someone holding onto the seat. If the legs are cut, a short, sharp stub of metal will be left. Depending on the circumstances, the best way to remove seats may be to remove the securing bolts.

A large number of victims can present a logistical problem to the rescuers. Organization of the accident scene is important. Establishing a triage area on each side of the bus should be considered. Usually, the closer victims are to the point of impact, the more serious their injuries are and the more difficult it is to get to them.

The presence of a large amount of fuel is also a potential problem. The fire hazard is of prime importance, and a spill must be foamed and closely monitored. Spilled fuel will make surfaces very slippery. Care must be taken when walking and transporting victims and tools to prevent further injury to the victims and injury to the rescuers.

Training, coordination, and the utilization of resources are required to efficiently and effectively handle a major bus incident. If there are numerous victims, extra equipment and an extra workforce should be called immediately.

Extrication from Trucks

Like a bus accident, an incident involving a semi-truck presents a unique situation for rescuers. During stabilization, heavy wreckers and heavy-duty equipment may be required in order to secure the vehicle in a safe position. Trucks often carry some type of

heavy load that may have to be removed, especially if another vehicle has run underneath the truck cab or trailer, or the truck has rolled over. It is important for all rescuers to be aware of specialized equipment and personnel available to respond to rescue operations in extrication from large trucks.

Truck accidents also present the most frequent exposure of hazardous material to the rescuer. It is essential that rescue personnel be familiar with hazardous material identification and exposure procedures (see the chapter on hazardous materials).

Routine disentanglement procedures can be used in accidents involving large trucks; however, remember that it may be necessary to improvise in order to complete the job in a safe, effective manner.

Victim care consideration is the same as in any extrication situation. Victims should be removed in the manner previously discussed; however, when working with large vehicles, rescuers may have to use ladders or other equipment to remove victims safely.

CONCLUSION

The techniques and procedures presented cannot begin to address every extrication situation that may be encountered; however, this chapter does provide the rescuer with basic information. Through practical application of these procedures during training sessions, the rescuer will develop a thorough knowledge of tools used in extrication, their limitations, and the skills needed to use them. Training also provides essential hands-on experience which is difficult to acquire during actual emergencies.

It is necessary for the rescuer to change and modify rescue techniques or improvise new procedures when an unusual problem presents itself. Above all, the rescuer must maintain self-control and exercise common sense in extrication procedures.

SUGGESTED TOOLS AND EQUIPMENT FOR EXTRICATION PROCEDURES

If a department is going to be involved in extrication procedures, a variety of tools is necessary to do the job efficiently and safely. The following information identifies some of the essential equipment, tools, and supplies that may be needed by the rescue service at the accident scene.

Basic Gear for Each Rescuer

- Protective coat (flame-retardant material)
- Protective helmet
- Coverall-type, softside safety goggles
- Lightweight leather gloves
- Turnout pants (optional)
- Safety shoes (as part of uniform)
- Short fire fighter's boots for each rescuer
- Fluorescent orange, reflective-striped vest
- Barrier-type, polylaminated safety suit
- Approved dust respirator
- Self-contained, positive-pressure protective breathing apparatus
- Spare cylinder for each breathing apparatus

Supplies Needed for Protection Against Tools and Flying Objects

- 2 sheets of plywood 18" x 30" or a folding shield
- 2 - 4' x 8' salvage covers

Gear Needed for Protection Against Radiant Heat and Flames

- 1 aluminized rescue blanket in a protective pouch

Gear Needed for Protection from the Elements

- 1 golf umbrella
- 1 aluminized survival blanket (in cold climate areas)
- 1 lightweight vinyl or coated paper tarpaulin
- 2 disposable paper blankets for protecting an accident victim's head, eyes, ears, and lungs
- 2 coverall type, softside safety goggles
- 2 earmuff-style hearing protectors
- 12 approved disposable dust masks
- 12 disposable thermal masks (for cold weather areas)
- 1 special valve for the portable oxygen delivery system that provides a continuous flow to a patient in a hostile environment

Equipment Needed for Fire Suppression

- 1 - 5-lb. A:B:C dry chemical fire extinguisher
- 1 - 20-lb. A:B:C dry chemical fire extinguisher

- 1 - 2 1/2-gallon pressurized water fire extinguisher
- 1 - 10-lb. Halon 1211 fire extinguisher

Equipment Needed for the Stabilization of a Wrecked Vehicle and Other Mechanisms to Deal with Entrapment

- 2 wheel chocks
- 24 lengths of 2" x 4" x 18" wood cribbing
- 12 lengths of 4" x 4" x 18" hardwood wedges
- 24 lengths of 4" x 4" x 18" wood cribbing
- 12 lengths of 4" x 4" x 48" wood cribbing
- 6 - 24" x 24" x 3/4" plywood
- 6 - 18" x 48" x 3/4" plywood
- 5 lbs. Number 16 double-head nails
- 2 - 6" diameter x 18" rollers

Supplies Needed for Stopping the Flow of Flammable Fuel

- 1 package of plastic leak-sealing compound or duct sealant
- 12 wood golf tees

Supplies Needed for Breaking Tempered Glass Windows

- 1 can of adhesive spray
- 1 roll of translucent adhesive-backed shelf paper

Equipment Needed for Animal Control

- 1 animal noose

Supplies Needed for Moving a Downed Wire

- 2 lineperson's glove sets in protective pouches
- 2 pairs of spare rubber glove inserts
- 1 can of talcum powder
- 1 lineperson's clampstick set
- 1 lineperson's telescoping hot stick

Supplies Needed for the Identification of Hazardous Commodities

- 1 - 7 x 50 power armored binocular
- 1 hazardous material action guide

Miscellaneous Items Needed for Hazard Control Operations

- 1 plastic jug filled with cat litter
- 1 roll of 2" or 3" cloth-backed duct tape
- 1 folding, pointed-blade shovel
- 1 folding tree saw
- 12 lengths of split 1 1/2" fire hose
- 6 - 12" lengths of 1 1/2" or 3" fire hose
- 4 elastic shock cords with S-hooks, two 24" long and two 36" long

Items Needed for Spectator and Traffic Control Operations

- 24 - 30-minute pyrotechnic flares with wire stands
- 2 red or fluorescent red or orange warning flags with staffs
- 2 traffic-control flashlights

Miscellaneous

- 1 set of replacement flashlight batteries
- 1 roll of high-visibility barrier tape
- 2 - 110-volt, 300-watt or 500-watt floodlights with stands
- 1 - 100' length of 3-wire extension cord terminating in a junction box or "Y"
- 2 battery-powered hand lights
- 1 set of replacement batteries for each hand light
- 6 chemical light sticks
- 1 - 12-volt trouble light with a 25-foot cord and battery clips
- 4 battery-powered fluorescent lights
- 1 generator, minimum 7500-watt, 110-volt
- 1 - 8" adjustable wrench
- 1 - 12" adjustable wrench
- 1 - 8" combination aircraft snips
- 1 steel-shank awl
- 1 manual or spring-loaded center punch
- 1 - 1" x 12" cold chisel
- 1 combination wrench set (box and open end)
- 1 - 3-lb. drilling hammer
- 1 folding SAE lug wrench
- 1 folding metric lug wrench
- 3 hacksaw frames fitted with 12" 18 teeth per inch high-speed shatterproof blades
- 12 replacement blades for the hacksaw frame
- 1 hacksaw frame fitted with a tungsten-carbide rod saw
- 1 replacement tungsten-carbide rod saw
- 1 folding SAE hux wrench set
- 1 folding metric hux wrench set
- 2 linoleum knives
- 1 locksmith's noose tool
- 1 mini-hacksaw
- 2 - 12" to 15" short flat pry bars

- 1 panel cutter
- 1 replacement blade for the panel cutter
- 1 - 14″ pipe wrench
- 1 - 8″ battery plier
- 1 - 8″ needle-nose plier
- 1 - 8″ side-cutting plier
- 1 - 8″ slip-joint plier
- 1 - 10″ locking-type plier
- 1 - l0″ water pump plier
- 1 - 2″ x 8″ ripping chisel
- 1 - 12″ standard-blade square-shank screwdriver
- 1 - 8″ standard-blade square-shank screwdriver
- 1 - 10″ Phillips screwdriver
- 1 - 8″ Phillips screwdriver
- 1 - 4″ Phillips screwdriver
- 1 - 10″ cabinet blade screwdriver with a 3/16″ tip
- 1 socket wrench set with ratchet and extensions (standard and metric)
- 2 spray containers filled with liquid soap solution (for lubrication)
- 1 torx screwdriver set
- 1 utility (razor) knife
- 5 replacement blades for utility knife
- 2 windshield knives
- 1 replacement blade for windshield knife

Porta-power Tools Needed for Extrication

- 2 - 15″ spreader tools with pumps
- 2 wedger tools with pumps
- 2 - 4 ton rams with pumps
- 2 - 10 ton rams with pumps
- 1 chain puller set-up with chains
- Extension tubes (5″, 10″, 15″, 20″) with various base plates and couplers

Power Hydraulic Tools Needed for Extrication

- Necessary chains and shackles
- 1 - 24″ to 32″ spreader tool
- 1 power cutter
- 1 power ramset (30″ and 60″)
- 1 portable power unit
- 1 reel with 100′ of hose
- 1 abrasive cutting saw
- 1 chain saw
- 1 reciprocating saw with high-speed shatterproof blade
- 1 circular saw with carbide blade
- 1 air chisel with bits
- 1 each - 1/4″ and 3/8″ air ratchets
- 1 - 1/2″ impact wrench
- 1 tire inflation chuck
- 6 tire deflation tools
- 1 high-pressure air bag system
- 1 each - Various bag sizes: (6″ x 6″; 12″ x 12″; 14″ x 48″; 10″ x 10″; 24″ x 24″)
- 1 air hose reel with 100′ of hose
- 1 fixed air supply with regulator
- 1 portable air supply with regulator
- 1 air manifold
- 1 ax-style combination forcible entry tool
- 1 - 36″ or 42″ bolt cutter
- 1 - 36″ or 42″ combination forcible entry tool
- 1 - 6-lb. flat head fire ax
- 1 - 51″ or 60″ steel pinch-point crow bar
- 1 - 8-lb. 36″ sledgehammer
- 2 - 2 ton, rated chain or cable hand winches
- 2 - 2-piece rescue chain set or 3-piece rescue strap sets
- 1 - 3-piece rescue strap set
- 1 - 2-piece J-hook and chain set
- 2 - 10 or 12 ton hydraulic post jacks with pumps
- 1 mechanical jack
- 2 lengths of 1/2″ static kernmantle rope (for use as a lifeline)
- 2 lengths of 3/8″ static kernmantle rope (for use as utility lines, not lifelines)
- 1 minimum 8000 lb. winch with snatch-locks, chains, cables, and boom poles
- 2 long spine boards with straps and head immobilizers
- 1 - 1″ nylon rope sling with sliding closure
- 1 scoop-style stretcher
- 1 patient carrying device suitable for horizontal or vertical carrying
- 2 - 1/2″ static kernmantle ropes in throw bags
- 10 - 16″ lengths of 1″ tubular nylon webbing
- 1 full body harness
- 10 locking D carabiners
- 6 figure-eight descent devices
- 4 locking-type ascent devices
- 1 - 1/2″ single sheave rope pulley
- 1 - 3/8″ single sheave rope pulley